FIGURE 1 (Prior Art)

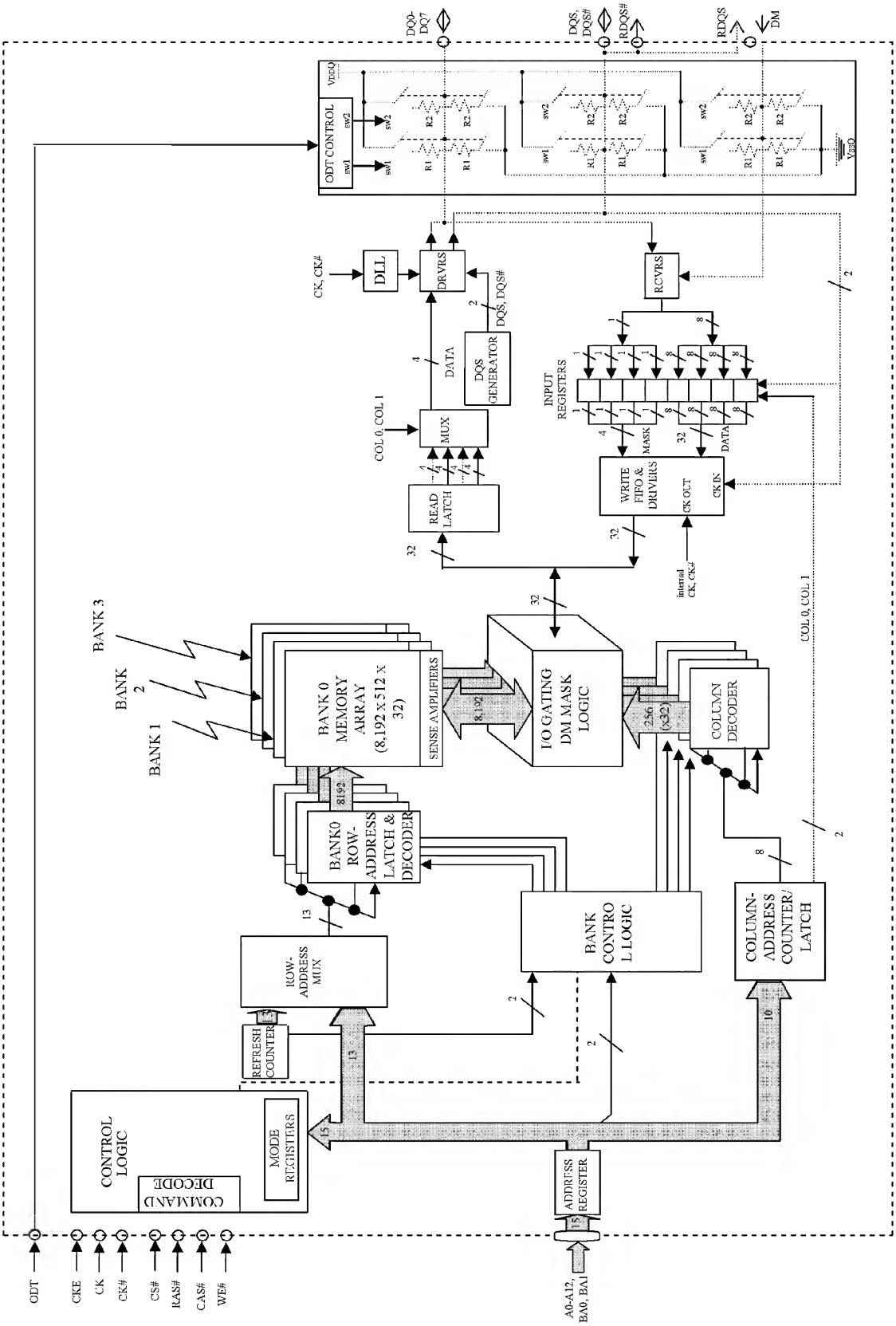


FIGURE 2 (Prior Art)

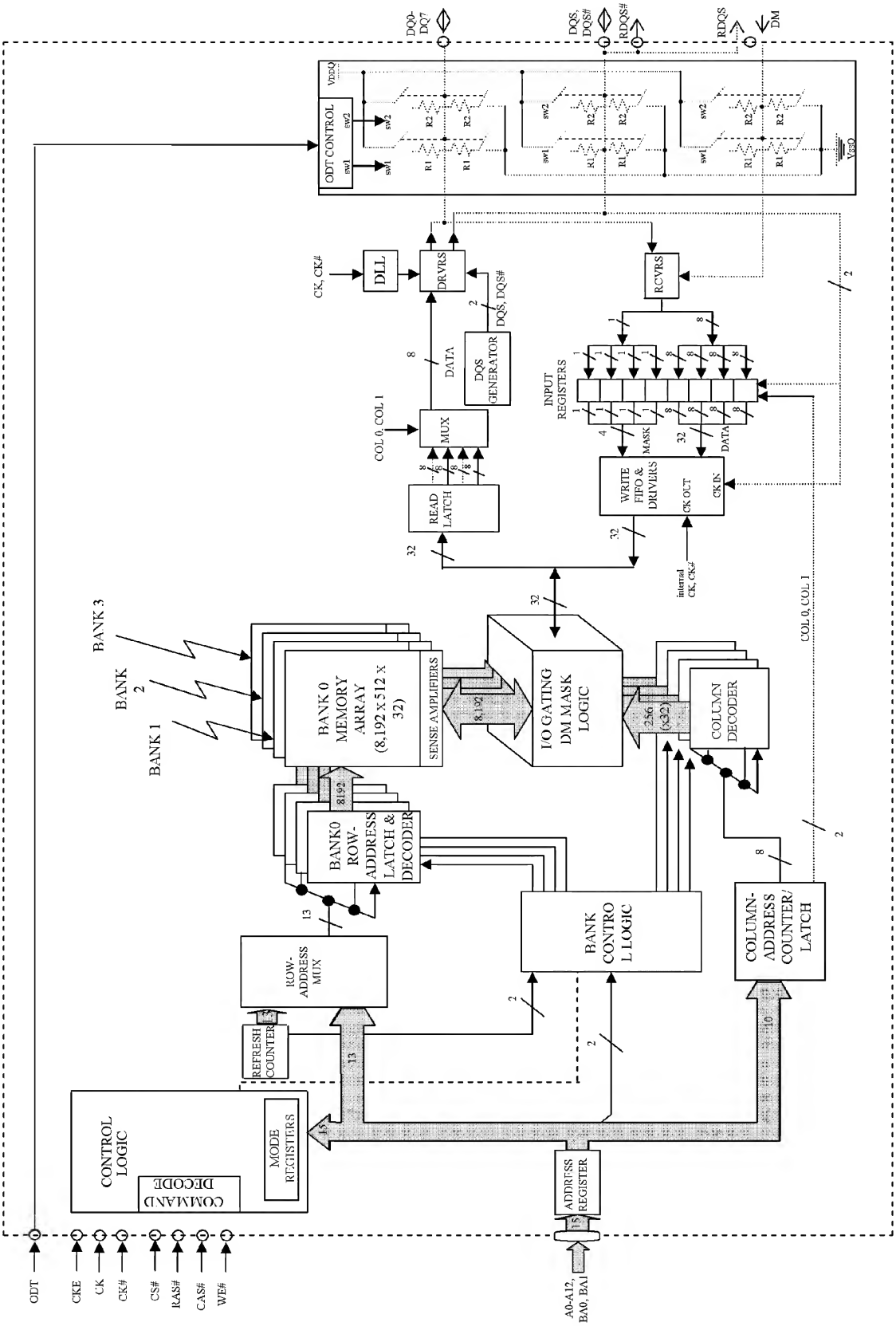
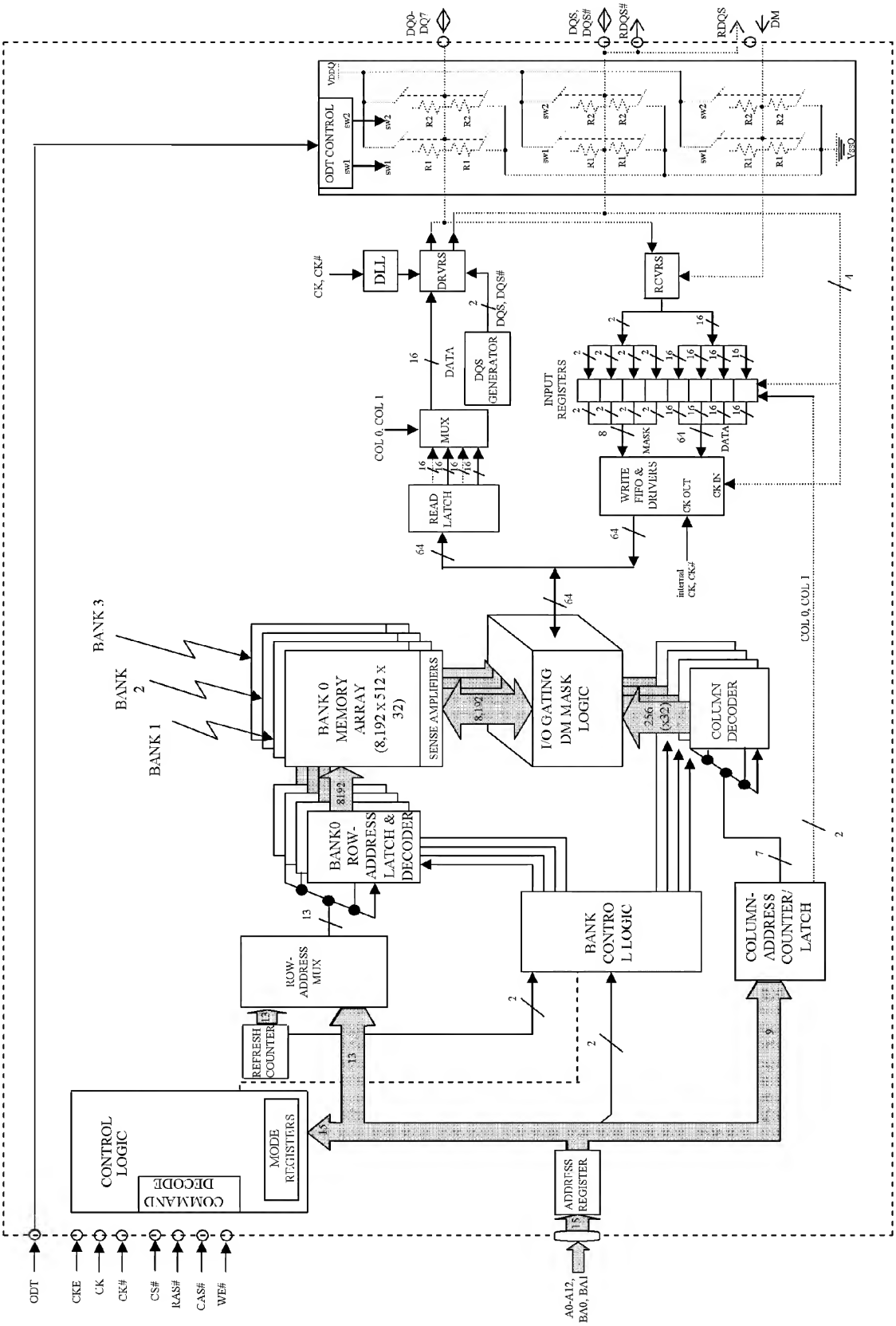


FIGURE 3 (Prior Art)



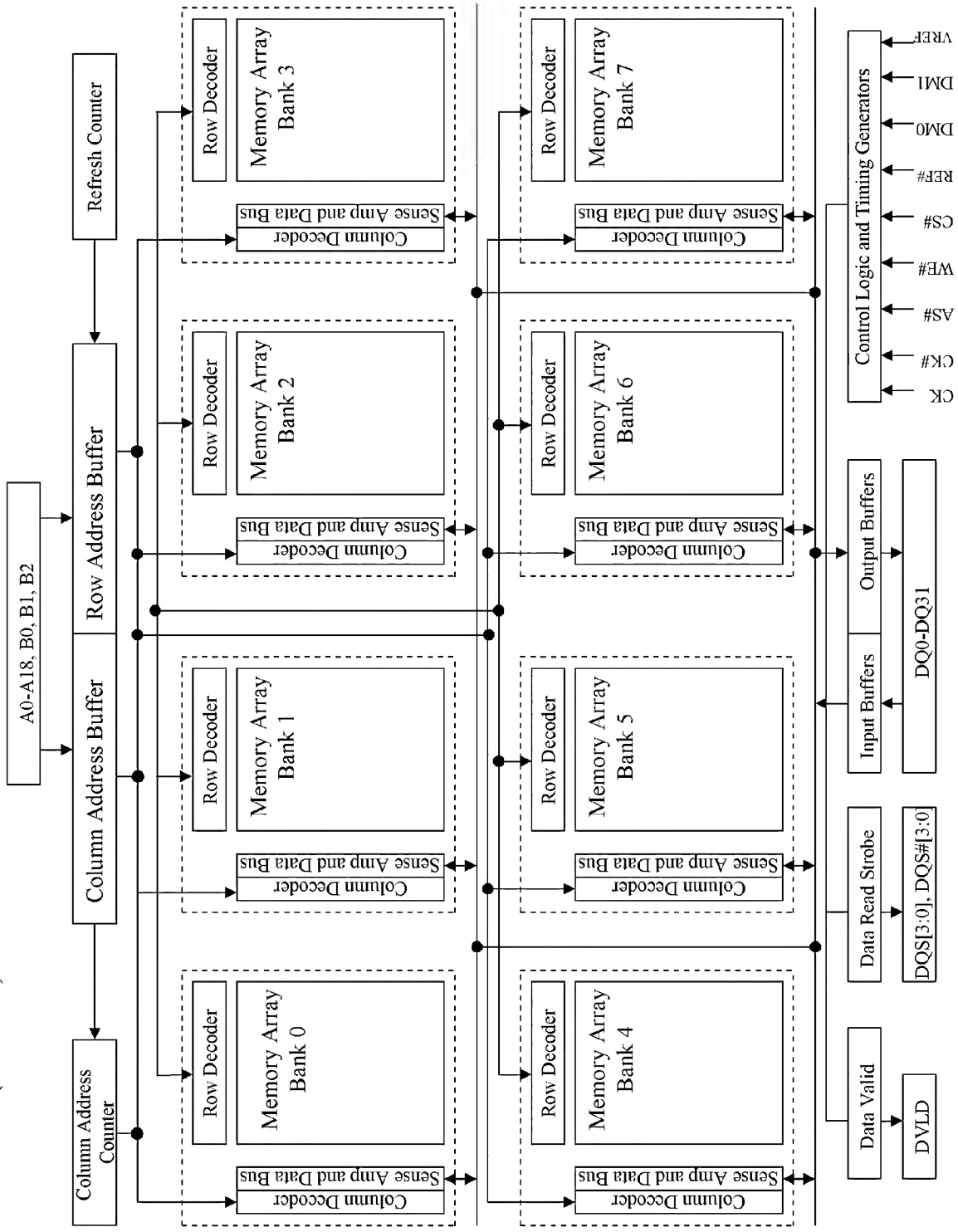
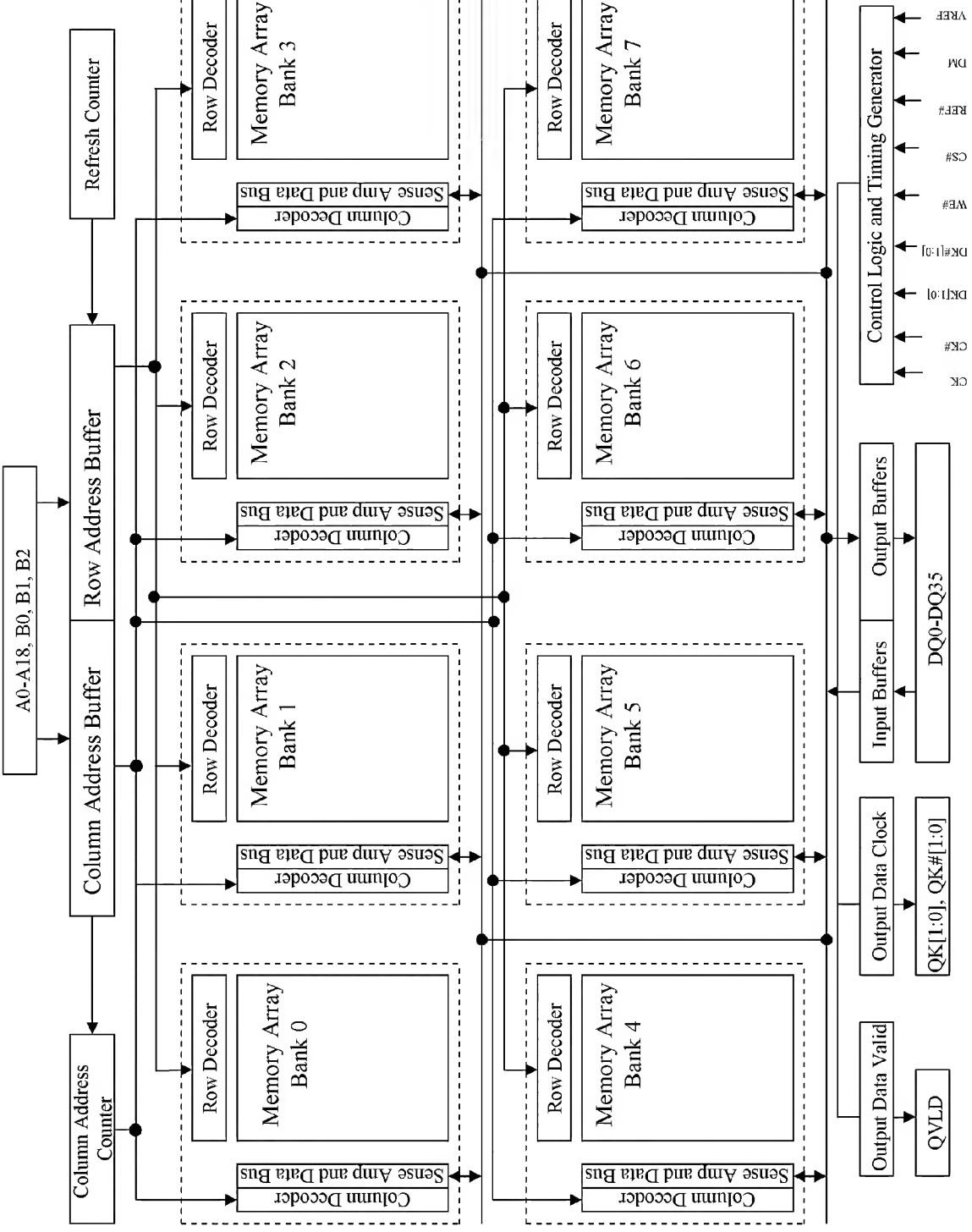


FIGURE 4
(Prior Art)

FIGURE 5
(Prior Art)



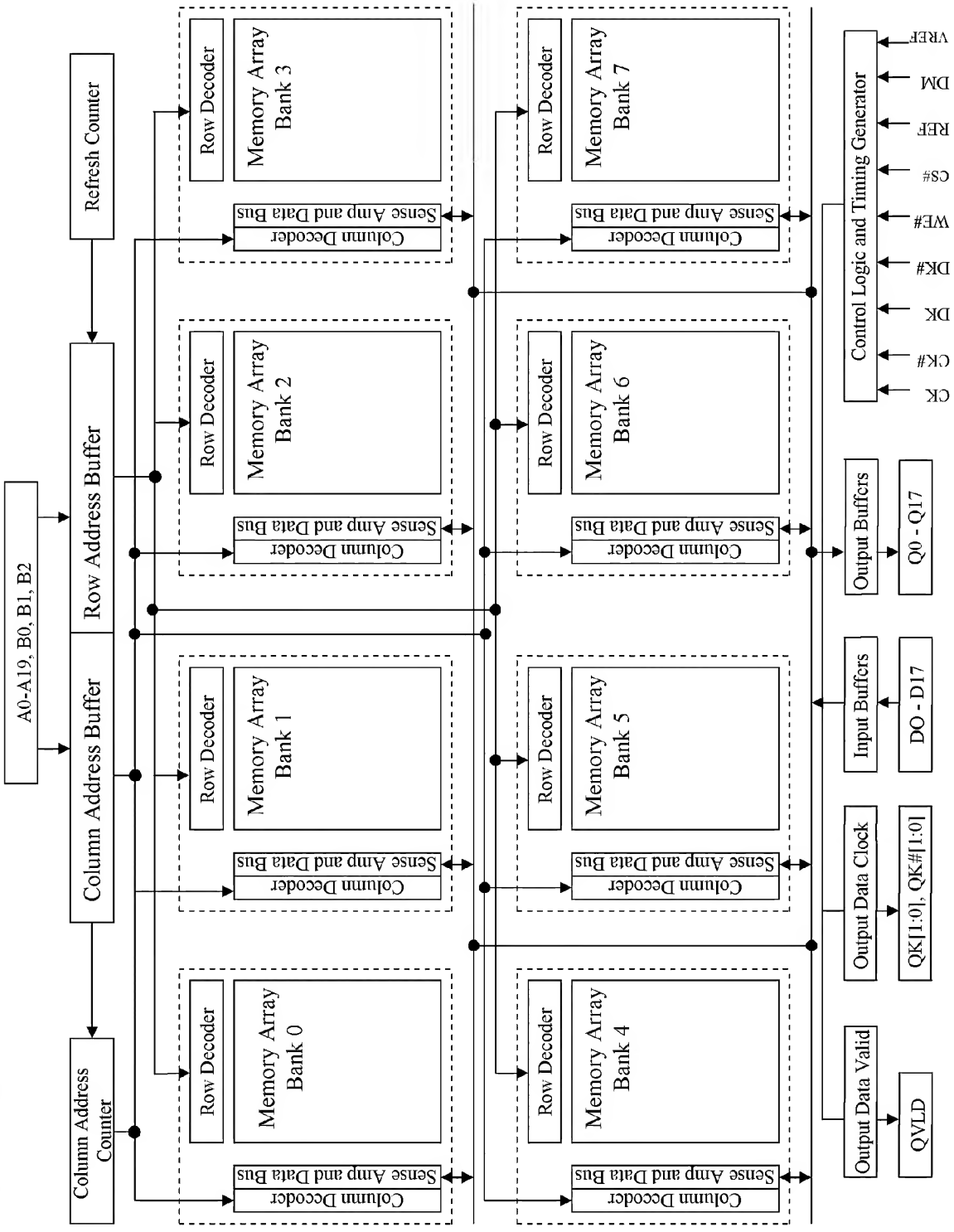


FIGURE 6
(Prior Art)

FIGURE 7

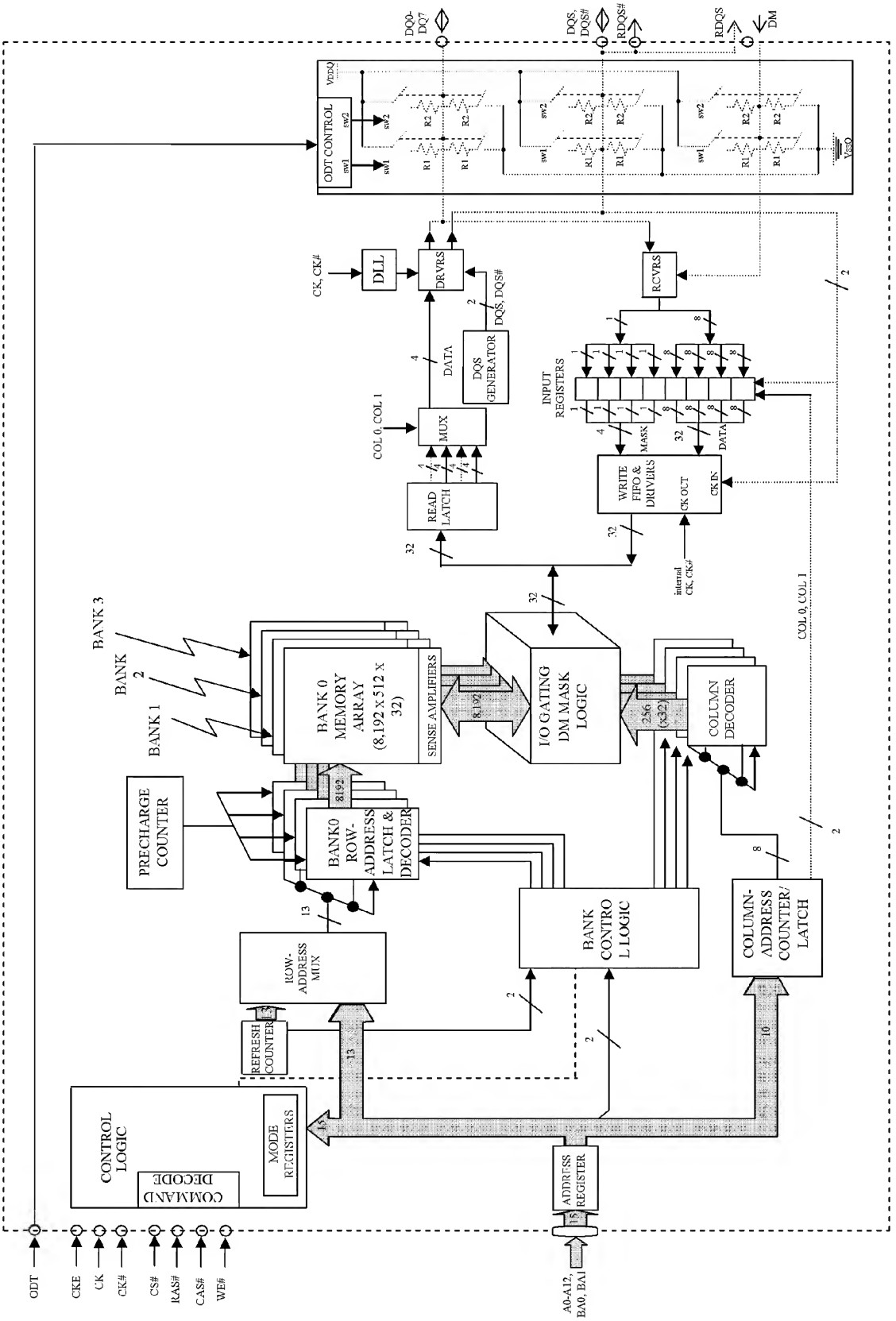

ODT
CKE
CK
CK#
CS#
RAS#
CAS#
WE#
A0-A12, BA0, BA1
CONTROL LOGIC
COMMAND DECODE
MODE REGISTERS
REFRESH COUNTER
ROW-ADDRESS MUX
ADDRESS REGISTER
BANK CONTROL LOGIC
COLUMN-ADDRESS COUNTER/ LATCH
PRECHARGE COUNTER
BANK0 ROW-ADDRESS LATCH & DECODER
BANK 3
BANK 2
BANK 1
BANK 0 MEMORY ARRAY (8,192 x 512 x 32)
SENSE AMPLIFIERS
I/O GATING DM MASK LOGIC
COLUMN DECODER
COL 0, COL 1
READ LATCH
MUX
DATA
DQS GENERATOR
DLL
DRVRS
RCVRS
INPUT REGISTERS
WRITE FIFO & DRIVERS
CK OUT
CK IN
internal CK, CK#
ODT CONTROL
VDDQ
VSSQ
DQ0-DQ7
DQS, DQS#
RDQS#
RDQS
DM

FIGURE 8

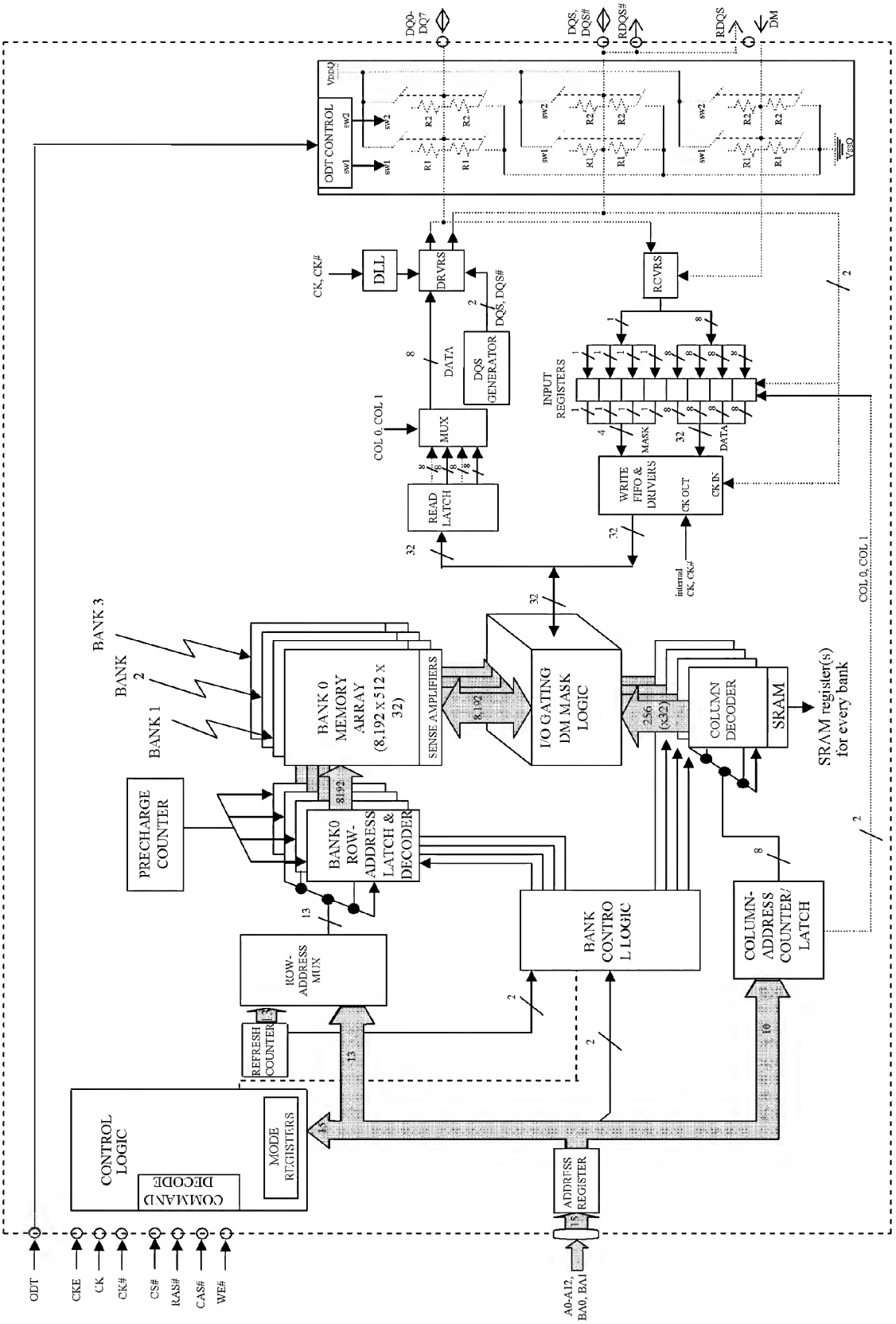

ODT
CKE
CK
CK#
CS#
RAS#
CAS#
WE#
A0-A12, BA0, BA1
CONTROL LOGIC
COMMAND DECODE
MODE REGISTERS
REFRESH COUNTER
ROW-ADDRESS MUX
BANK CONTROL LOGIC
ADDRESS REGISTER
COLUMN-ADDRESS COUNTER/ LATCH
PRECHARGE COUNTER
BANK0 ROW-ADDRESS LATCH & DECODER
BANK 0 MEMORY ARRAY (8,192 x 512 x 32)
SENSE AMPLIFIERS
I/O GATING DM MASK LOGIC
COLUMN DECODER
SRAM
SRAM register(s) for every bank
BANK 3
BANK 2
BANK 1
READ LATCH
MUX
DATA
DQS GENERATOR
DRVRS
DLL
CK, CK#
DQS, DQS#
WRITE FIFO & DRIVERS
MASK
DATA
CK OUT
CK IN
INPUT REGISTERS
RCVRS
internal CK, CK#
COL 0, COL 1
ODT CONTROL
VDDQ
VSSQ
DQ0-DQ7
DQS, DQS#
RDQS#
RDQS
DM

FIGURE 9

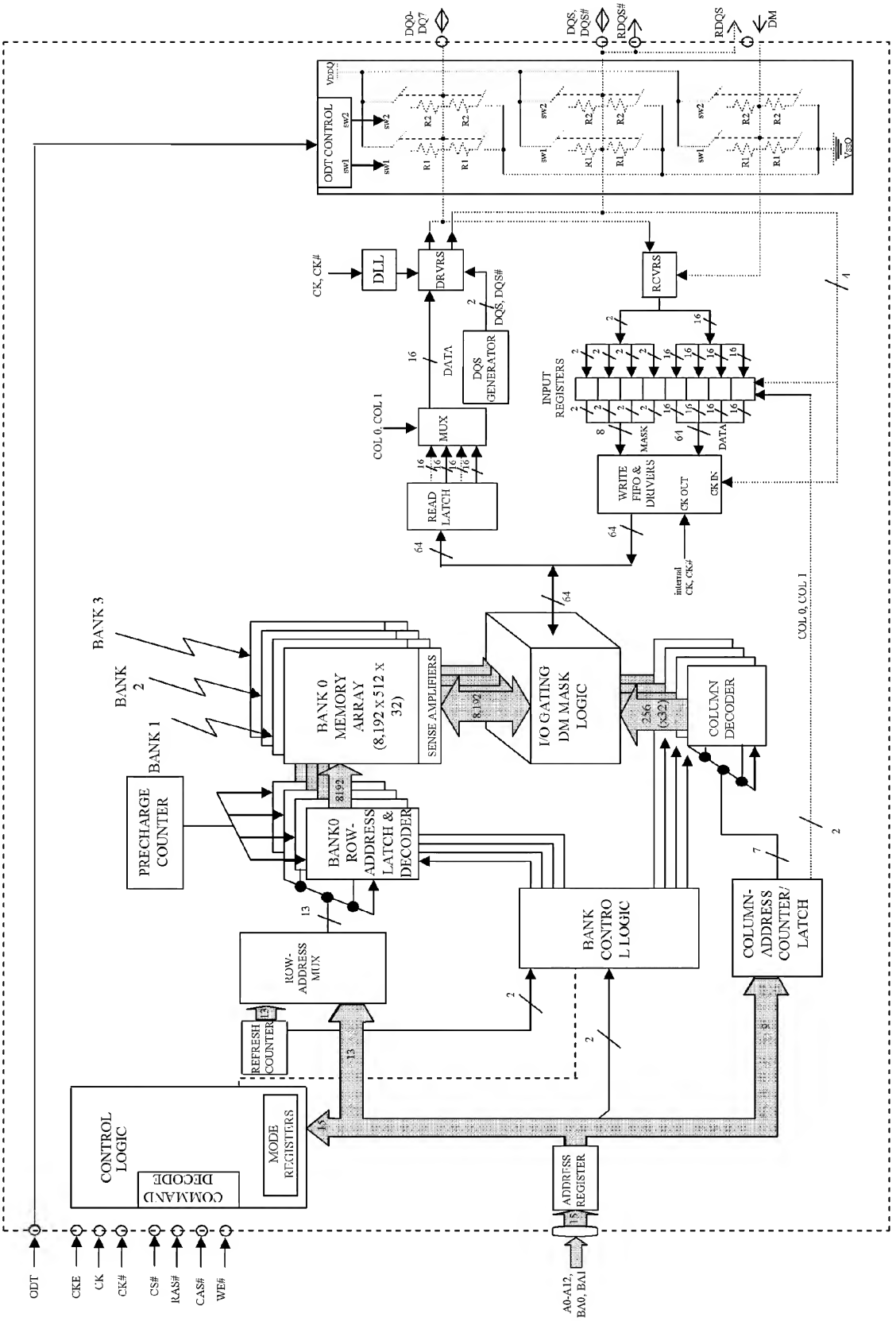
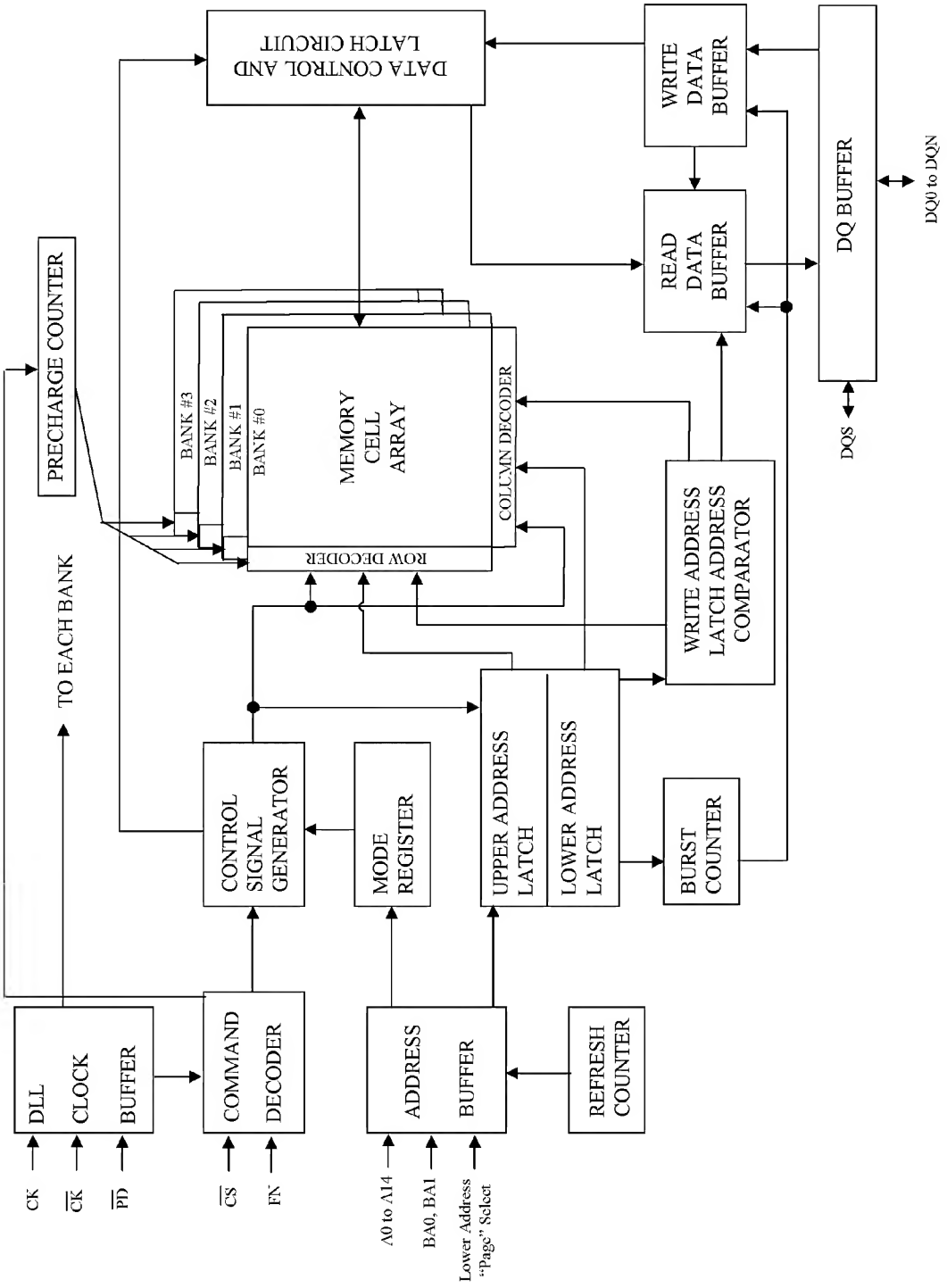

ODT
CKE
CK
CK#
CS#
RAS#
CAS#
WE#
A0-A12, BA0, BA1
CONTROL LOGIC
COMMAND DECODE
MODE REGISTERS
REFRESH COUNTER
ROW-ADDRESS MUX
ADDRESS REGISTER
BANK CONTROL LOGIC
COLUMN-ADDRESS COUNTER/ LATCH
PRECHARGE COUNTER
BANK0 ROW-ADDRESS LATCH & DECODER
BANK 0 MEMORY ARRAY (8,192 x 512 x 32)
SENSE AMPLIFIERS
I/O GATING DM MASK LOGIC
COLUMN DECODER
BANK 3
BANK 2
BANK 1
READ LATCH
MUX
DATA
DQS GENERATOR
DRVRS
DLL
CK, CK#
DQS, DQS#
WRITE FIFO & DRIVERS
CK OUT
CK IN
internal CK, CK#
INPUT REGISTERS
MASK
DATA
RCVRS
ODT CONTROL
VDDQ
VSSQ
DQ0-DQ7
DQS, DQS#
RDQS#
RDQS
DM
COL 0, COL 1

FIGURE 10


CK
$\overline{CK}$
$\overline{PD}$
DLL
CLOCK
BUFFER
$\overline{CS}$
FN
COMMAND
DECODER
A0 to A14
BA0, BA1
Lower Address "Page" Select
ADDRESS
BUFFER
REFRESH COUNTER
TO EACH BANK
PRECHARGE COUNTER
CONTROL SIGNAL GENERATOR
MODE REGISTER
UPPER ADDRESS LATCH
LOWER ADDRESS LATCH
BURST COUNTER
BANK #3
BANK #2
BANK #1
BANK #0
MEMORY CELL ARRAY
ROW DECODER
COLUMN DECODER
DATA CONTROL AND LATCH CIRCUIT
WRITE ADDRESS LATCH ADDRESS COMPARATOR
READ DATA BUFFER
WRITE DATA BUFFER
DQS
DQ BUFFER
DQ0 to DQN

Burst Read with Auto Precharge (JEDEC Standard DDR2 DRAM Specification, September 2003)

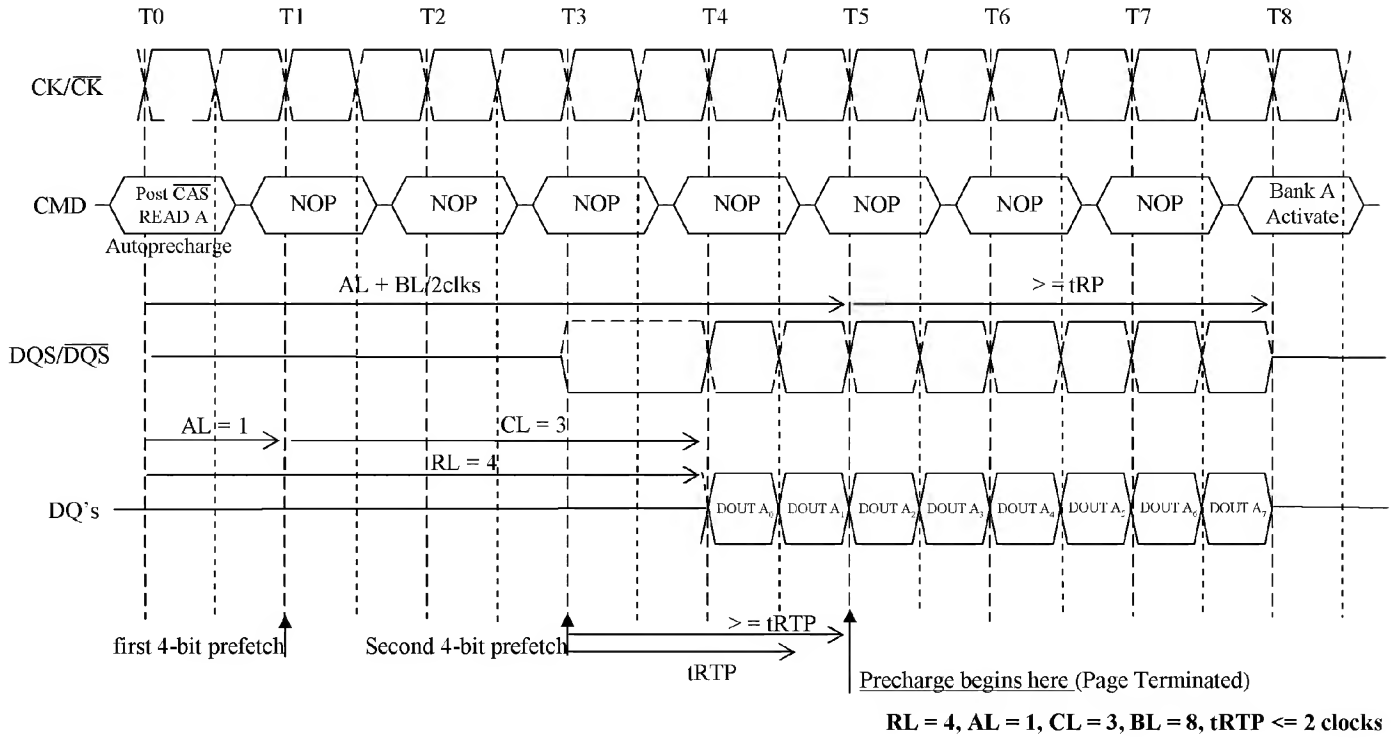


FIGURE 11

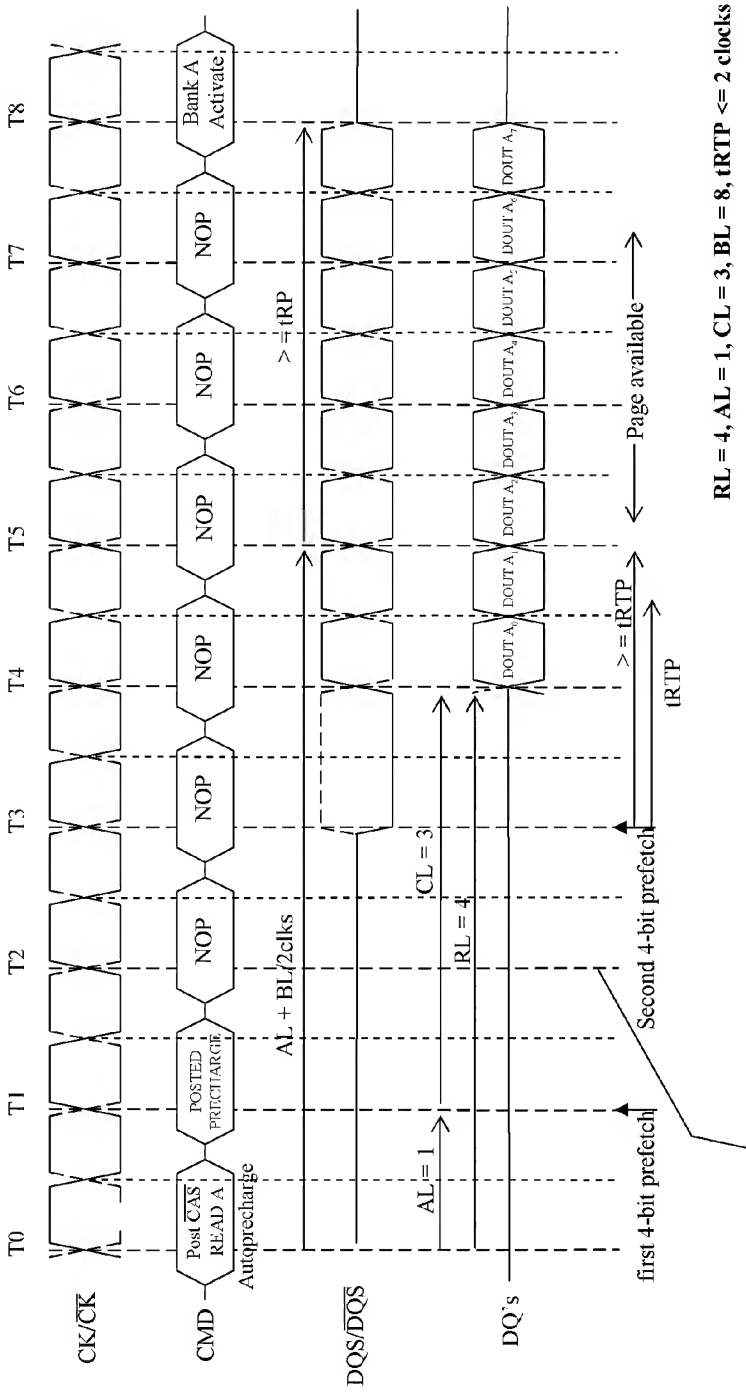

Burst Read with Posted Precharge
T0
T1
T2
T3
T4
T5
T6
T7
T8
CK/CK
CMD
Post CAS READ A
POSTED PRECHARGE
NOP
Bank A Activate
Autoprecharge
AL + BL/2clks
>= tRP
DQS/DQS
AL = 1
CL = 3
RL = 4
DQ's
DOUT A0
DOUT A1
DOUT A2
DOUT A3
DOUT A4
DOUT A5
DOUT A6
DOUT A7
first 4-bit prefetch
Second 4-bit prefetch
>= tRTP
tRTP
Page available
RL = 4, AL = 1, CL = 3, BL = 8, tRTP <= 2 clocks
Internal Precharge (Programmable) enable activated

FIGURE 12